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TORSIONAL RIGIDITY OF CENTRAL CALORIMETER MODULE

Mark Leininger

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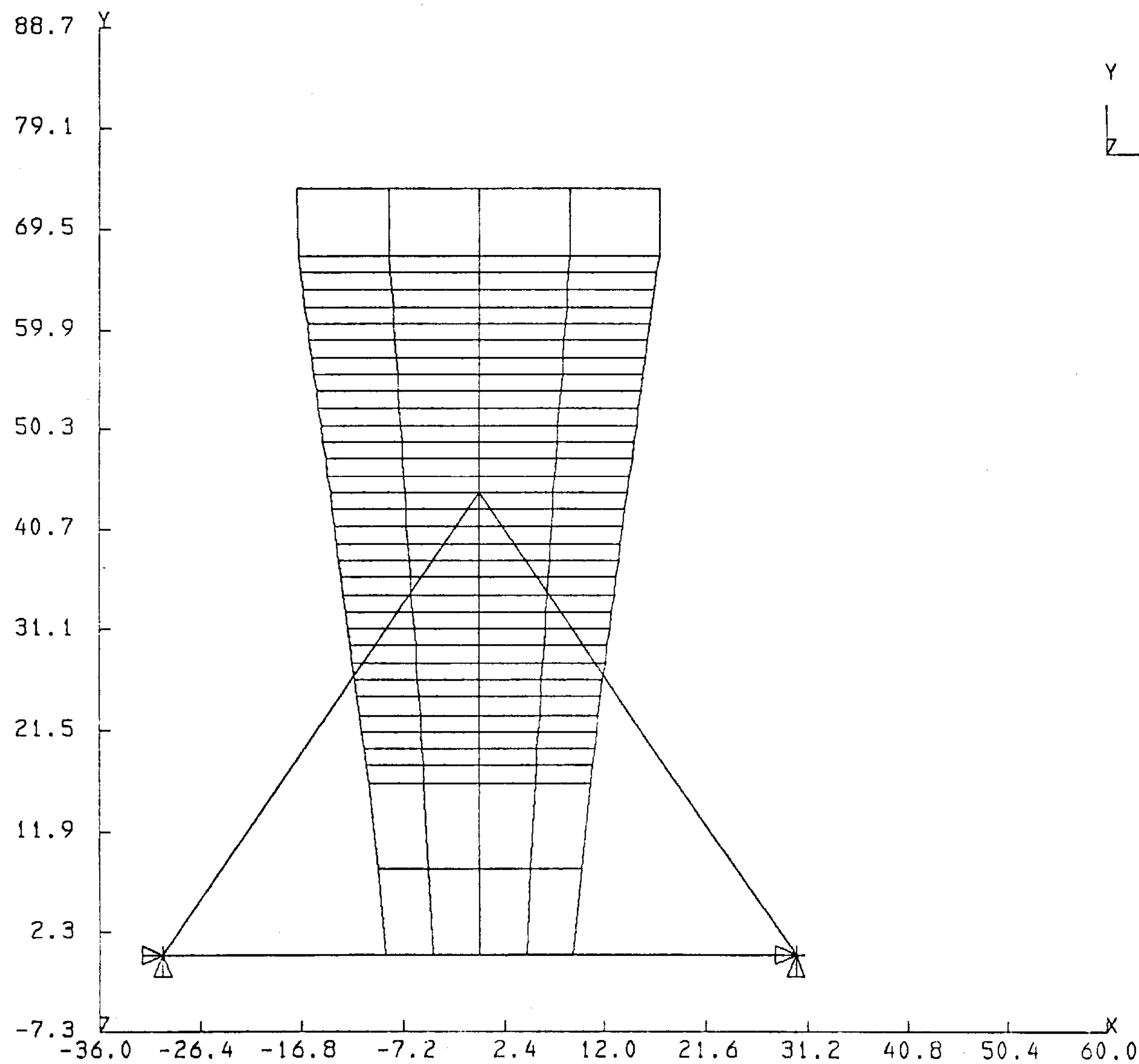
Abstract

The torsional rigidity of the central calorimeter module (Fig. 1 and 2) is obtained using ANSYS.

Introduction

The torsional rigidity of the central calorimeter module about its long axis (the axis perpendicular to the plane of the paper in Fig. 1) is of interest for several reasons: The technique used to lift and place the module in the cradle depends on how stiff the module is; the required accuracy of the cradle is in part determined by the amount of error the module will absorb due to its own flexibility. The torsional ridigity of a module has been determined using ANSYS.

Fig. 1



Model Check. Calorimeter Module Torsion

Fig. 2

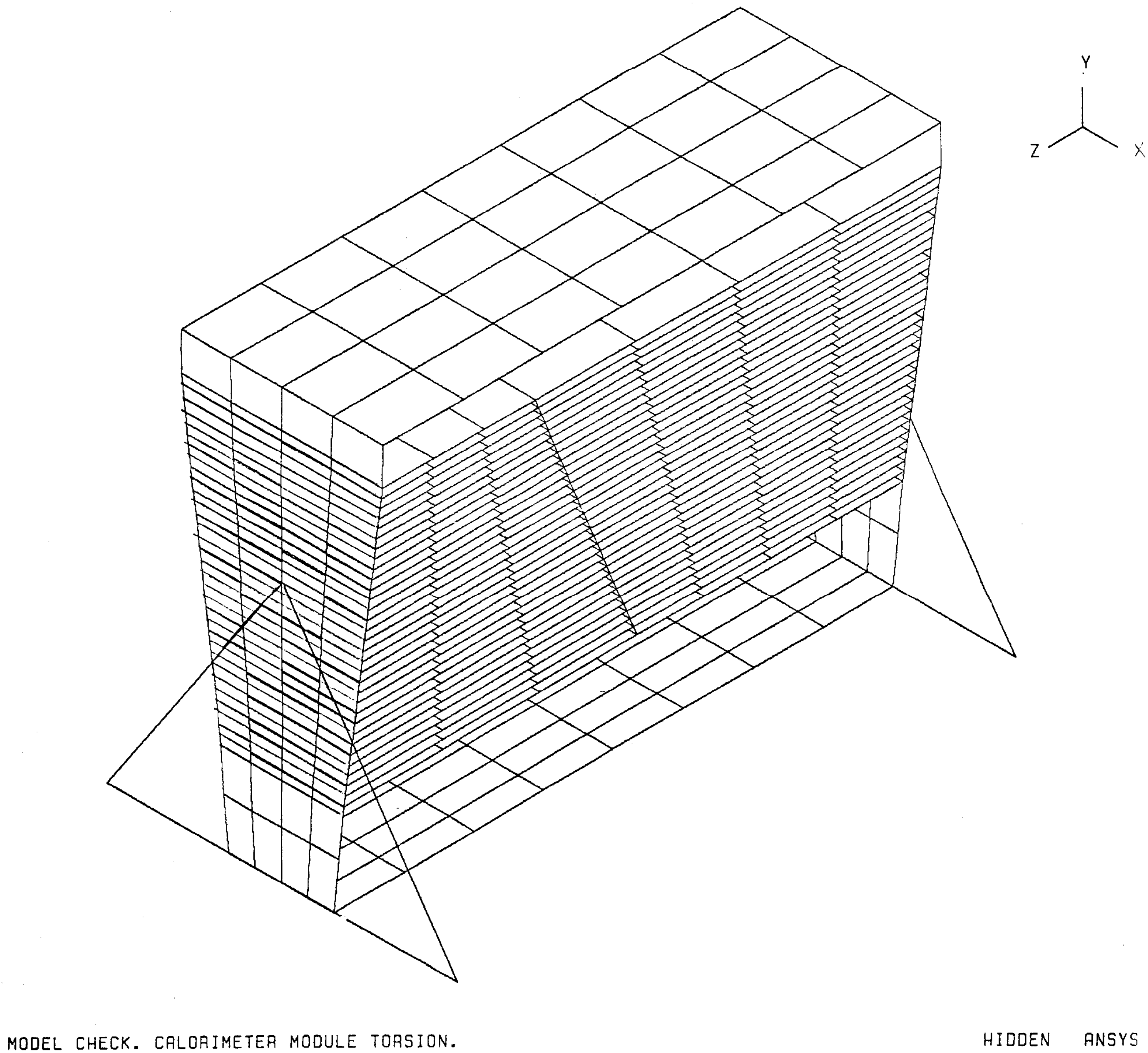
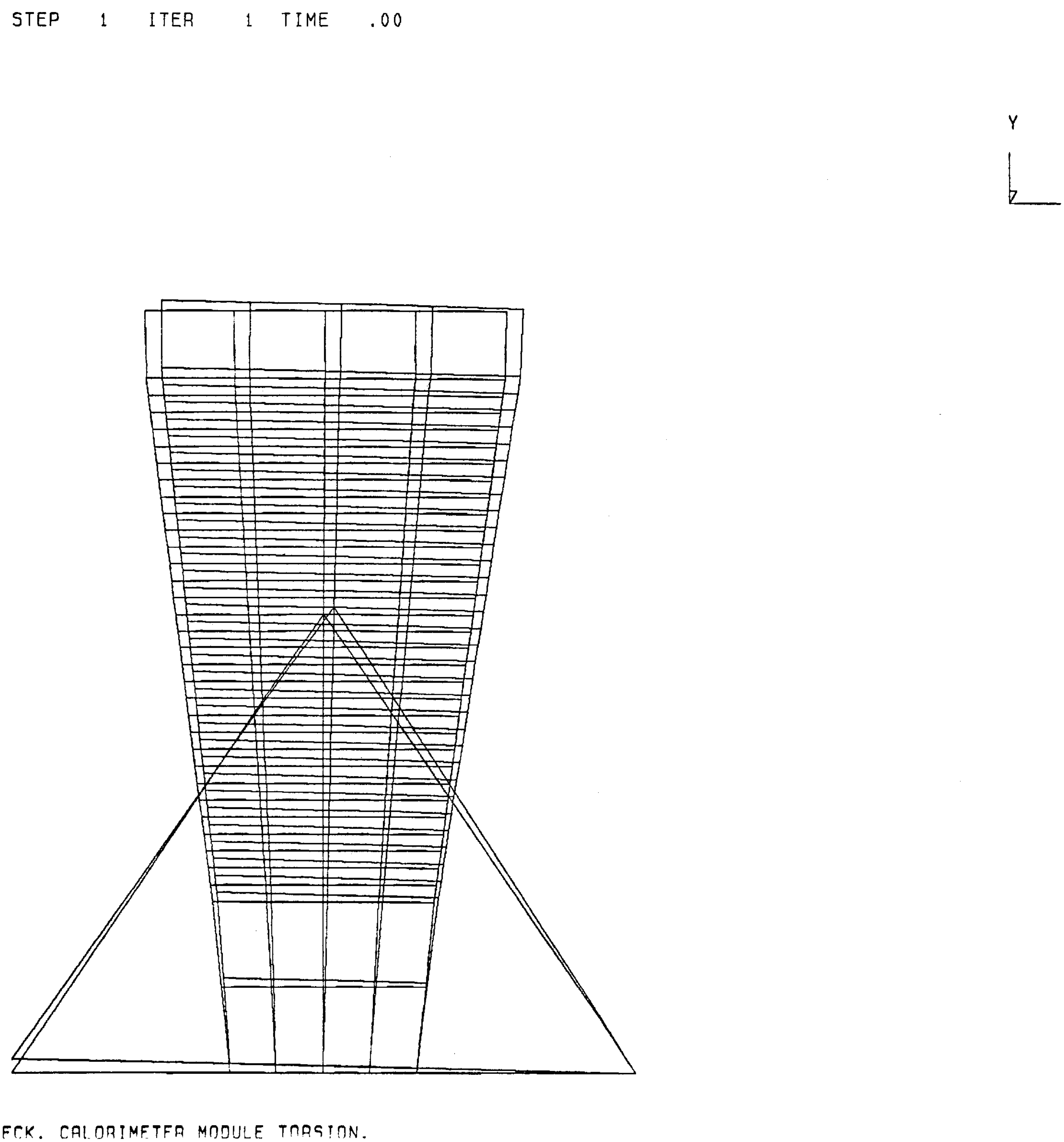


Fig. 3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MODEL CHECK. CALORIMETER MODULE TORSION.

Solution

Fig. 3 shows the distorted geometry plot resulting from lifting one corner of the module support stand .010 in. The support structure shown in Fig. 3 (looks like a truss) was modeled to match the geometry of the actual support stand and was given artificially high structural constants (Young's modulus = 30E10 psi, moment of inertia = 5000 in.^{4}, area = 500 in.^{2}) with an artificially low density to match its weight to the actual weight of the stand. This model assumes that the support stand is infinitely rigid compared to the module. The reaction forces at the four corners are shown (Fig. 4) after the corner has been lifted .010 in.

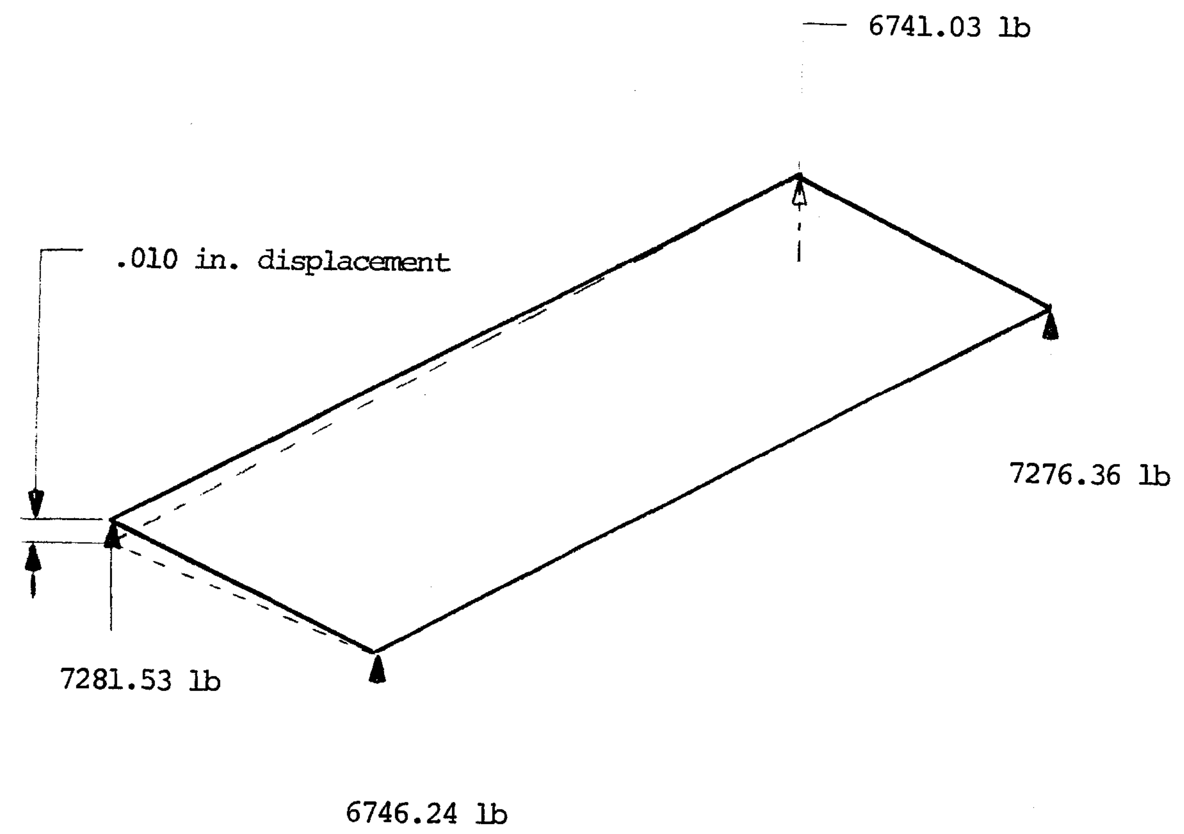


Fig. 4

The torque about the support stand axis is:

$$T = (7281.53 - 6746.24)(30) \text{ in. lb} = 16{,}059 \text{ in. lb.}$$

The angle of rotation is:

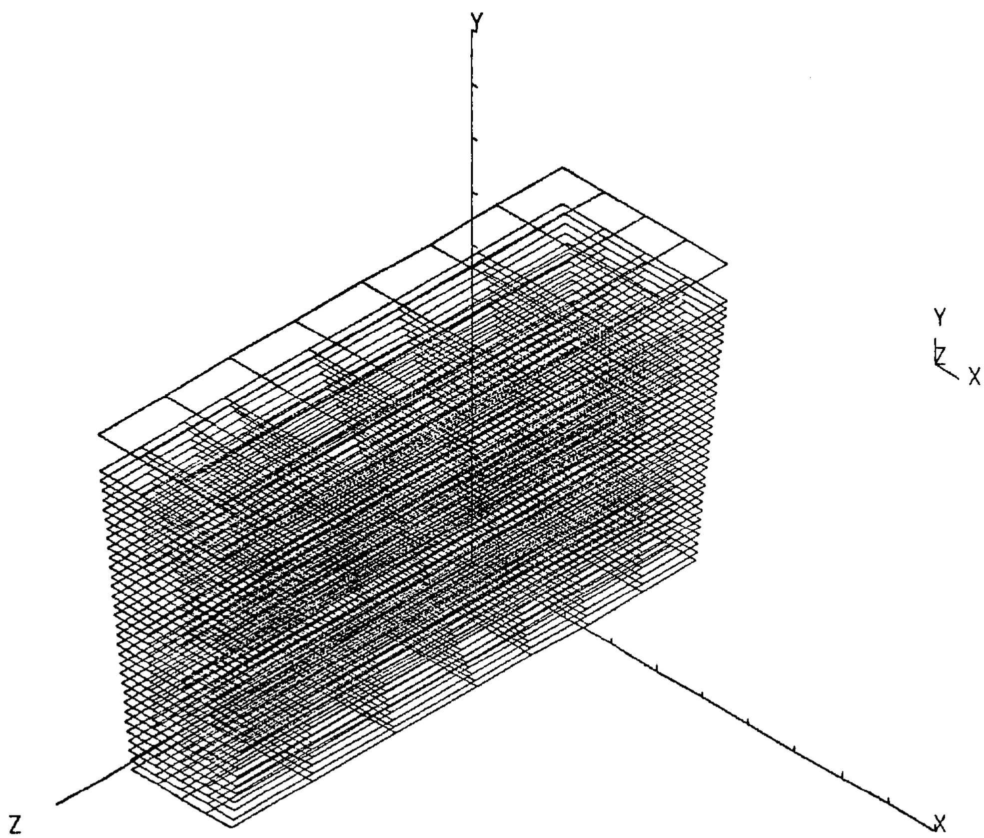
$$\phi = \sin^{-1}\left(\frac{.010}{60}\right) = 9.549\text{E-}3 \text{ degree.}$$

The torsional rigidity over the entire length of the module (96 in.) is then:

$$GJ = \frac{T}{\phi} = \frac{16{,}059 \text{ in. lb}}{9.549\text{E-}3 \text{ degree}} = 1.682\text{E}6 \; \frac{\text{in. lb}}{\text{degree}}$$

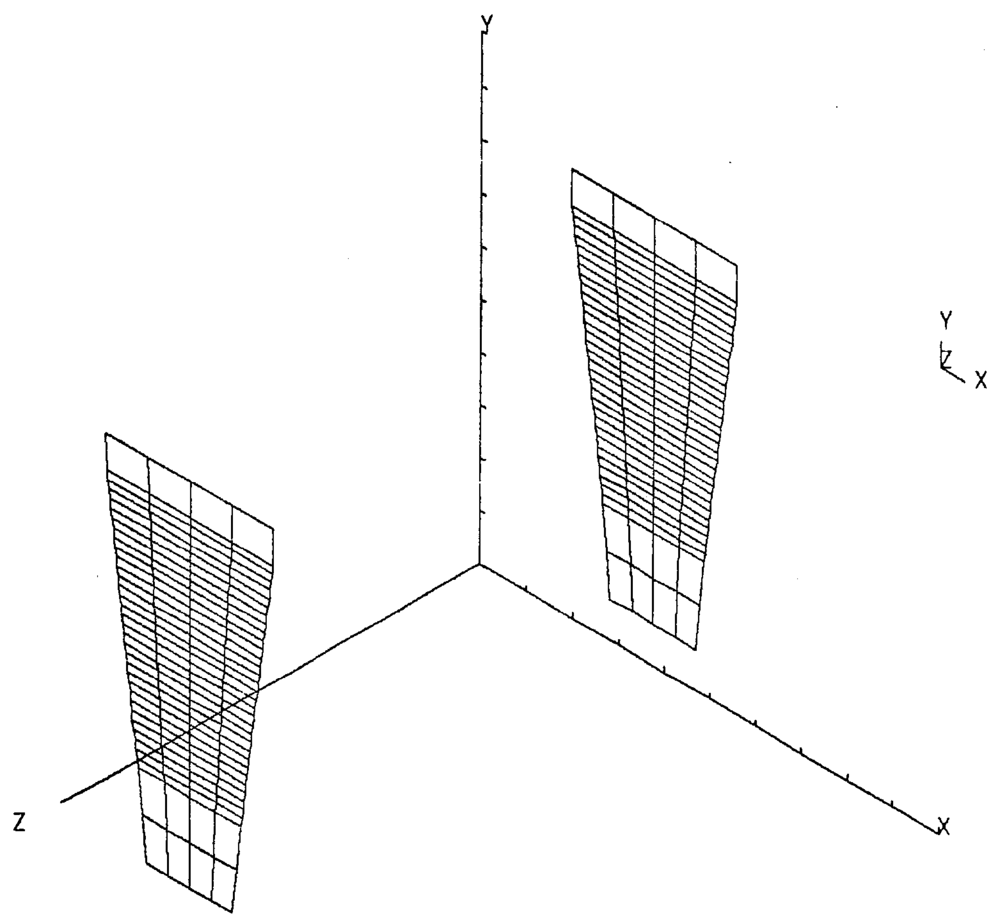
The module is, therefore, extremely stiff in torsion. Figs. 5-9 show the finite element mesh used for each component of the module.

Fig. 5



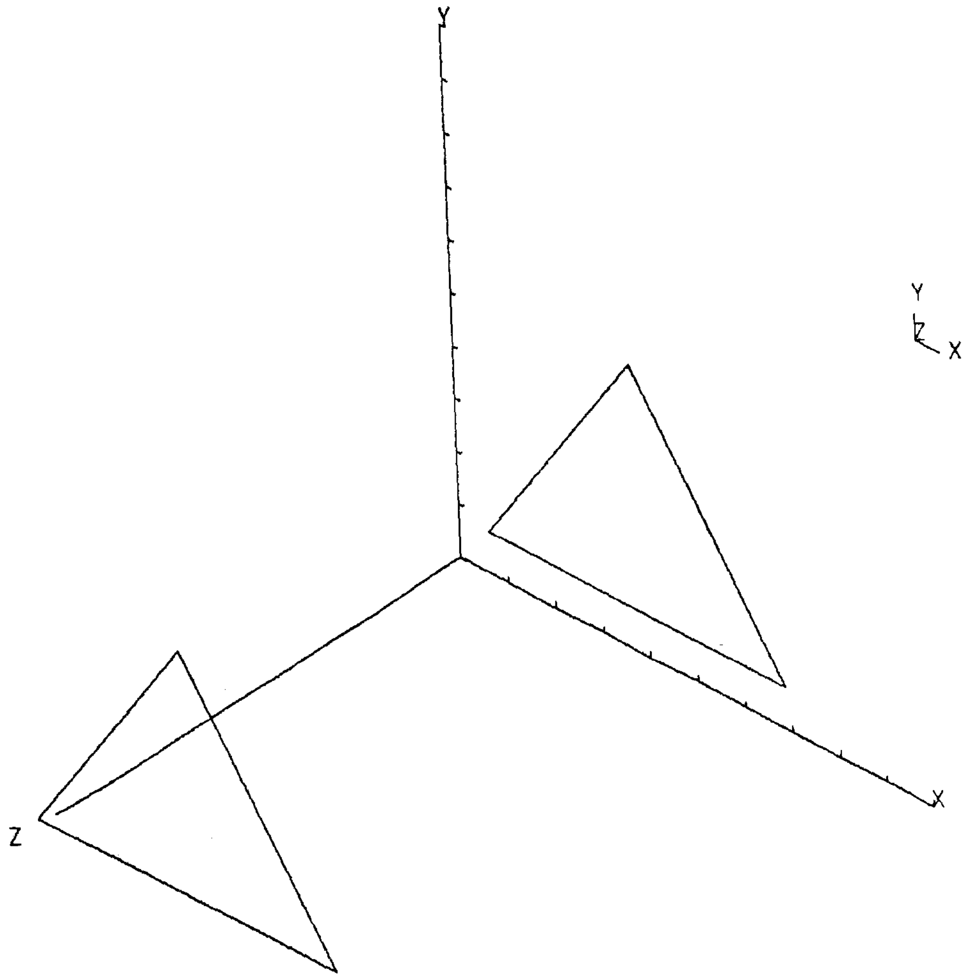
Model Check. Calorimeter Module Check.

Fig. 6



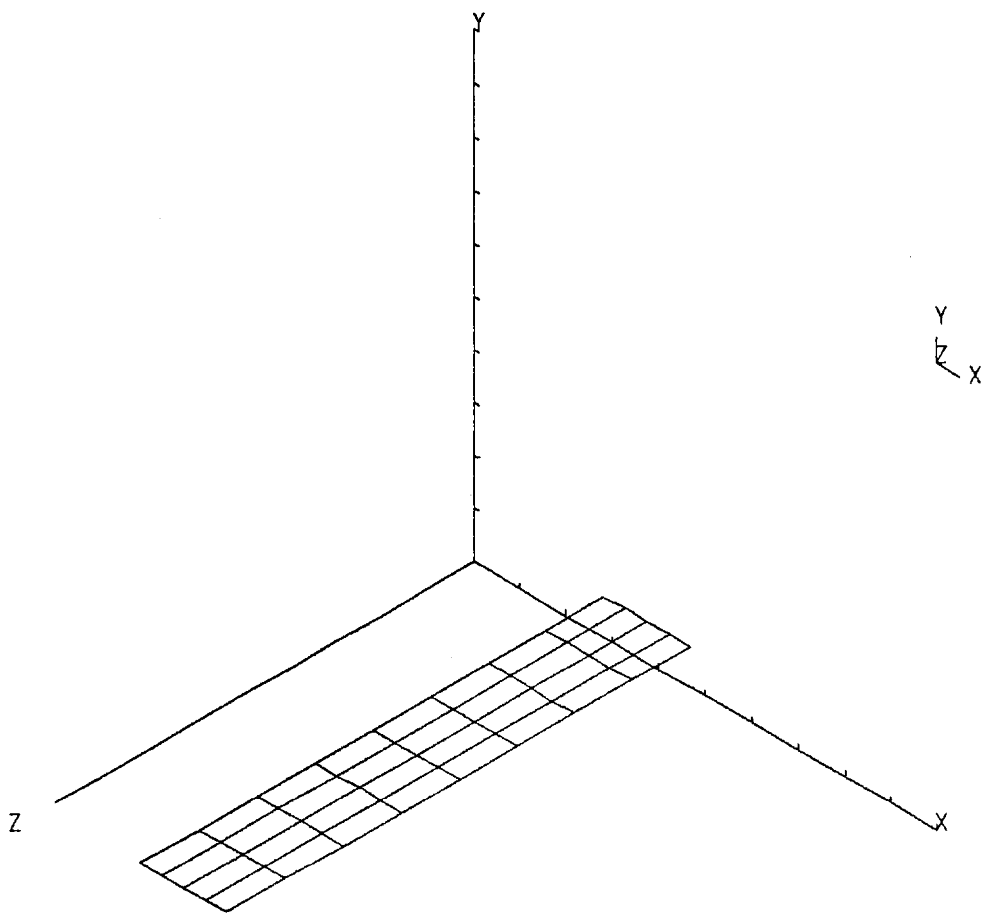
Model Check. Calorimeter Module Torsion.

Fig. 7



Model Check. Calorimeter Module Torsion

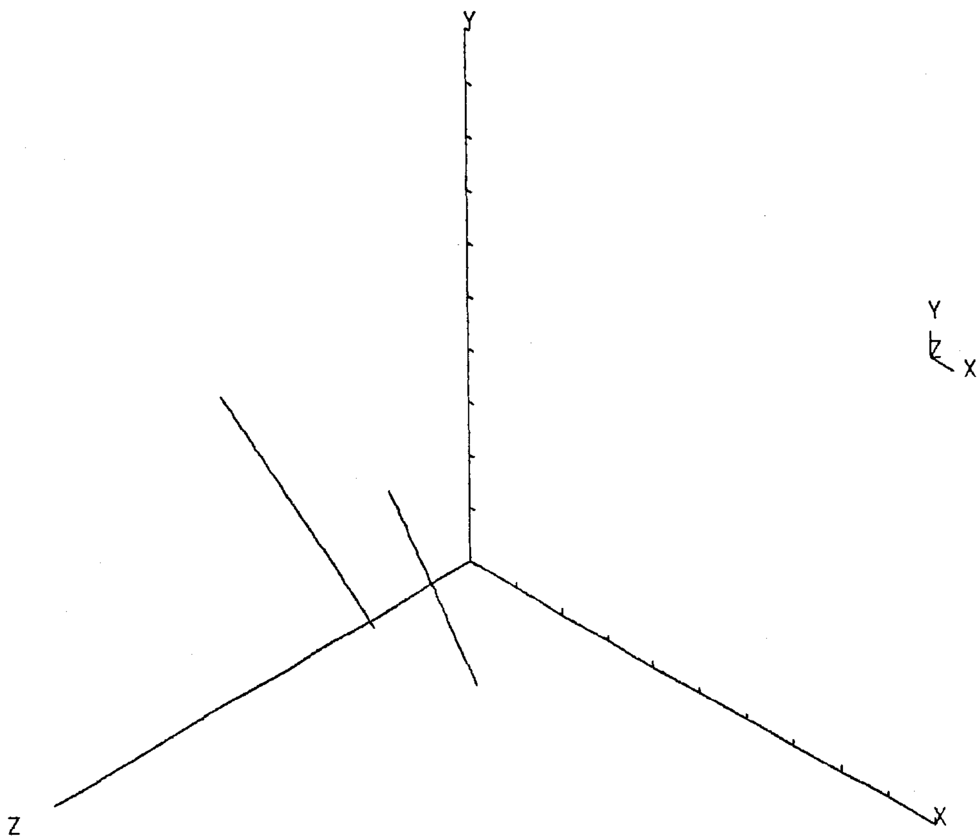
Fig. 8



MODEL CHECK. CALORIMETER MODULE TORSION.

GEOMETRY ANSYS 1

Fig. 9



Model Check. Calorimeter Module Torsion.